G. N. Hooper referred to the work done by the London Chamber of Commerce, and the discussion was continued by Messrs. Phillips, Burgess, Batalha Reis, and Yule Oldham. The President proposed that a committee, consisting of Chief Justice Daly (chairman), Prof. Levasseur, Prof. Lehmann, Mr. Mackinder, and Mr. Herbertson, should be appointed to consider a resolution on geographical education, to be submitted to the Congress.

Section C, which met at the same time, concerned itself with photographic surveying. The presidential chair was occupied by Prince Roland Bonaparte and General Walker jointly. In a paper read on his behalf by M. Schrader, Colonel Laussedat considered the application of photography to the rapid determination of points in levelling, and a combined camera and theodolite was exhibited. M. de Déchy, in discussion, insisted that photography must always be merely auxiliary to triangulation, and must not in any way replace it; and Mr. Coles described his work in constructing a map of the Caucasus from photographs alone. Captain E. H. Hills then read a paper on the determination of terrestrial longitudes by means of photography, in which he described improved methods of exposing and measuring plates used in photographing lunar distances, by means of which he had obtained better results than those obtained by Schlichter and Runge. An abstract of a paper by Prof. J. Thoulet, suggesting the extended application of photography to the survey of rapidly shifting sandbanks, was read in his absence. Mr. Coles described and exhibited Colonel Stewart's camera for producing photographs of the whole horizon, and the proceedings closed with an informal communication by M. Janet on the determination of longitudes without instruments of precision.

HELIUM, A CONSTITUENT OF CERTAIN MINERALS.[1]

II.

(II.) *The Properties of Helium.*

FROM what has preceded, it appears that up to now only three minerals are available as sources of helium, unless, indeed, very large quantities of samarskite and yttrotantalite are worked up. These three are clèveite, the uraninite investigated by Hillebrand, and bröggerite. And here we wish to express our indebtedness to Prof. Brögger for his great kindness in placing a large stock of bröggerite at our disposal. It has furnished a large quantity of the helium which we have had in our hands.

Although, so far as we were able to judge by throwing into a two-prism spectroscope of Browning's the spectra of samples of gases obtained from the minerals previously mentioned, all the specimens of helium were identical, still a further proof was desirable. Owing to the small quantities of gas yielded by these minerals, amounting in most cases to a few c.c., it was impossible to ascertain whether these samples were of the same density; but the case was different with the gas from clèveite and from bröggerite. In each case a sufficient quantity was obtained to make it possible to determine the density with fair accuracy. It will be convenient therefore to describe the methods of extracting the gas and the methods determining its density.

In the communication to the Royal Society it was stated that the maximum density of the original gas from cleveite was 3·89. The spectroscope showed the presence of nitrogen in this sample; the bands were very brilliant at high pressure, but on reducing the pressure the yellow line became brilliant, and the nitrogen spectrum disappeared. This always happens when the tube has platinum electrodes and a strong discharge is passed for a considerable time. An attempt was made to remove the nitrogen from this sample of gas by circulating it over red-hot magnesium; but an unfortunate accident caused the admixture of about its own volume of air, carrying with it argon, from which at present there is no known method of separating helium.

It appeared important to decide whether the gas evolved from these minerals is helium, or a compound of hydrogen and helium; for in the preliminary set of experiments the treatment was such that a hydride would have been decomposed either by sparking with oxygen or by passage over copper oxide at a red heat.

The result of experiments directed to this end is to show that no combined hydrogen is present. Gas was extracted from nineteen grams of bröggerite by heating it in a combustion-tube to dull redness; the combustion-tube was connected with a Töppler's pump by means of thick-walled india-rubber tubing, wired carefully. Special experiments showed that the leakage through the india-rubber amounted between Saturday and Monday to less than one small bubble. The bröggerite yielded about 75 c.c. of gas, a large portion of which was absorbed by caustic soda, leaving about 35 c.c. A second charge of 18·3 grams gave 58·5 c.c., and a third, of 22·1 grams, gave 66·0 c.c. The amount of gas evolved depends largely on the temperature. The evolution is rapid at first, but becomes very slow after three hours, and the heating was always stopped before all the gas which might have been extracted had come off. The last portions, as will be seen later, were extracted by fusion with hydrogen potassium sulphate.

This crude product from bröggerite blackened mercury, doubtless owing to the presence of hydrogen sulphide.

The density of this sample was determined; the data are these.

Volume of bulb	33·023 c.c.
Temperarure	22·9
Pressure (corr.)	766·7 mm.
Weight...	0·0327 gram
Density (O = 16)	11·90

The exceedingly small capacity of the bulb calls for some remark, but for no apology. The object here is, not to determine the density with the utmost accuracy, but to secure a guide, sufficient for our purpose, which will indicate the probable molecular weight. Now the hydrogen contained in such a bulb at 0° and 760 mm. weighs approximately 0·0030 gram. A sensitive balance by Oertling, adjusted for the special purpose, could easily be read to 0·00005 gram, without resorting to the the reading of oscillations of the pointer; and this gives an accuracy of 5 parts in 300, or 1·7 per cent. Hence the density of hydrogen, thus determined, might vary between 0·983 and 1·017. It is evident that such an approximation is quite sufficient for our present purpose. The total volume of this gas was 124·5 c.c. A solution of soda was introduced by means of a pipette, and after all absorption had ceased, the residue measured 78·0 c.c. The density was again determined.

Volume of bulb	33·023 c.c.
Temperature	21·6°
Pressure (corr.)	765·4 mm.
Weight	0·0058 gram
Density (O = 16)	2·105

This gas was now left in contact with palladium sponge for a night. The sponge was made by reducing the chloride in a current of hydrogen, at a dull red heat. As it was somewhat porous, it was hammered on a steel anvil before introducing it into the gas, which, of course, was confined over mercury. The contraction amounted to about 1/30th. The density was again taken.

Volume of bulb	33·023 c.c.
Temperature	19·2°
Pressure (corr.)	760·2 mm.
Weight	0·00630 gram
Density (O = 16)	2·284

This gas had undergone no treatment which was of a kind to remove combined hydrogen, unless, indeed—a very improbable assumption—it be supposed that the compound should be decomposed by contact with metallic palladium. The gas was therefore placed in contact with copper oxide, which had previously been heated to redness in a vacuum, and a tube filled with phosphoric anhydride was so interposed as to absorb any water produced. The gain in weight of this tube was 0·0016 gram, indicating the oxidation of about 2 c.c. of hydrogen. In all probability this hydrogen had remained over after treatment with palladium; for it bears no proportion to the total quantity of gas—78 c.c.

The density was again determined.

Volume of bulb	33·023 c.c.
Temperature	16·67°
Pressure (corr.)	754·9 mm.
Weight	0·00720 gram
Density (O = 16)	2·606

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[1] A paper by Prof. William Ramsay, F.R.S., Dr. J. Norman Collie, and Mr. Morris Travers, read before the Chemical Society on June 20. (Continued from p. 308.)

We give thus minutely all the determination of density of such samples, because, although they refer to an imperfectly purified sample, yet they show that the density is very low, and they trace, moreover, the gradual change as one ingredient after another is removed.

The bröggerite which had been heated in a vacuum was next fused in successive portions with hydrogen potassium sulphate. A large quantity of gas was evolved, consisting of sulphur dioxide, carbon dioxide, nitrogen, and helium. The sulphur dioxide was removed with chromic mixture, and the carbon dioxide with caustic soda; the yield was 45 c.c. The density was then determined.

Volume of bulb	33·023 c.c.
Temperature	16·18°
Pressure (corr.)	753·3 mm.
Weight	0·01035 gram
Density (O = 16)	3·748

No alteration in volume occurred on passing the gas for several hours over red-hot copper oxide. Hence no hydrogen was present in the free state; and if combined, passage over copper oxide does not decompose the hydride, as was seen before, when the water produced was weighed. It may be remarked that every known hydride would yield its hydrogen on such treatment.

This sample of gas was next circulated over red-hot magnesium for several hours. It is hardly necessary to state that the magnesium was first heated to redness in a vacuum so as to remove hydrogen. In case any should escape removal, however, a red-hot tube of copper oxide formed part of the circuit, as well as a tube filled with phosphoric anhydride. Some caustic soda solution was present in the reservoir above the mercury, which would have absorbed the products of combustion of any hydrocarbon present. The density of this gas was calculated from the data appended.

Volume of bulb	33·023 c.c.
Temperature	14·88°
Pressure (corr.)	756·0 mm.
Weight	0·00845 gram
Density (O = 16)	3·037

On examining the magnesium tube, after it had cooled, it was found that on moistening it ammonia was evolved. The gas was, therefore, again circulated over magnesium, at a somewhat higher temperature, so high, indeed, that the gas must have passed repeatedly through magnesium vapour. On pumping out the tubes, an accident led to the loss of a few c.c. of gas; hence the weighing bulb had to be filled at a somewhat reduced pressure. The density is given below.

Volume of bulb	33·023 c.c.
Temperature	18·33°
Pressure (corr.)	615·8 mm.
Weight	0·0049 gram
Density (O = 16)	2·187

Again, on moistening the broken magnesium tube, ammonia was evolved; it was recognised by its odour and by its turning red litmus paper blue.

A further experiment was made with bröggerite. 30·8 grams were heated in a vacuum and the gas was collected over mercury, on to the surface of which a few c.c. of caustic soda solution were introduced. The yield of gas was 65 c.c. It was circulated over copper oxide to remove hydrogen, and its density was then determined.

Volume of bulb	33·023 c.c.
Temperature	19·70°
Pressure (corr.)	756·7 mm.
Weight	0·0068 gram
Density	2·481

The density of this sample is almost coincident with that of a previous sample, 2·606, obtained in the same way, after it had been purified from hydrogen. This gas was next circulated over very hot magnesium, so as to remove nitrogen. Again, it is certain that for many hours the gas must have been mixed with magnesium vapour, for the magnesium had been completely volatilised out of the hot part of the combustion-tube, and had condensed at the cool end. Again, the product, when moistened showed the reactions of ammonia, proving that nitrogen had been removed. The density of this sample was next taken.

Volume of bulb	33·023 cc.
Temperature	19·17°
Pressure (corr.)	756·7 mm.
Weight	0·0056 gram
Density	2·044

The copper oxide tube was omitted during this circulation; hence the density was low, 2·044. The spectrum of this gas showed hydrogen lines and feeble nitrogen bands. A second determination of density, in which the bulb was freshly filled, gave, at the same pressure and at a temperature differing by only 1° from the previous one, an identical weight. Further circulation for a whole day over red-hot magnesium, raised to the highest temperature which the tube could stand, gave a specimen from which hydrogen and nitrogen were absent; at least, the barest trace was visible in a vacuum-tube filled at a fairly high pressure; and care was taken to interpose a red-hot copper oxide tube, and, as usual, a tube containing phosphorus pentoxide. The effect of this circulation was to raise the density.

Volume of bulb	33·023 c.c.
Temperature	17·1°
Pressure (corr.)	763·2 mm.
Weight	0·0060 gram
Density (O = 16)	2·152

It is of interest to note that this sample, procured by heating bröggerite in a vacuum, has a density practically identical with that of gas obtained by fusing bröggerite with hydrogen potassium sulphate; that sample had density 2·187.

We next proceeded to extract the gas from 6·96 grams of Swedish clèveite. When heated in a vacuum, the gas was rapidly evolved at first, more quickly than from broggerite. About 60 c.c. were obtained, and, after treatment with soda, the residue occupied 26·3 c.c. As this was not sufficient for our purpose, and as we had already by density and spectrum proved the identity of gas evolved from bröggerite on heating, and on fusion with acid sulphate, the remaining clèveite was mixed with about five times its weight of fused and dried hydrogen potassium sulphate, placed in a tube, and heated in a vacuum. A further quantity of gas was evolved, which was at once treated with caustic soda solution. Both quantities of gas were mixed. This sample was then circulated over copper oxide for several hours, and the density was then determined with the following result.

Volume of bulb	33·023 c.c.
Temperature	19·43°
Pressure (corr.)	763·2 mm.
Weight	0·0061 gram
Density	2·205

The spectrum of this gas showed the merest trace of nitrogen, but no hydrogen. The density, it will be seen, is practically coincident with that of the gas from bröggerite. It is noteworthy that the gas from clèveite contains no nitrogen. We are absolutely certain that the presence of nitrogen in the gas from bröggerite is not to be explained by leakage of air, for the tightness of the apparatus was frequently tested during each operation.

We have therefore three determinations of density, and the mean may be taken as approximately correct to within 0·05. They are:

Gas from bröggerite by heating	2·152
Gas from bröggerite with $HKSO_4$	2·187
Gas from clèveite	2·205
Mean	2·181

All these samples of gas were now mixed and passed through the usual absorbents for nitrogen and for hydrogen, namely magnesium, copper oxide, soda-lime, and phosphoric anhydride. The density of this sample was then determined with the larger bulb. The error due to error in weighing cannot in this case amount to more than 0·3 per cent., and is probably less. Of course, the purity of the gas would affect the result. The data are as follows.

Volume of bulb	162·843 c.c.
Temperature	17·07°
Pressure (corr.)	764·9 mm.
Weight	0·03057 gram
Density (O = 16)	2·218

The wave-length of sound was determined with this sample of gas in a tube 1 metre in length and 9 mm. internal diameter; the vibrating rod was 580 mm. long. We found it exceedingly difficult to procure a tube in which really good sound-waves could be shown with helium; indeed, we were on several occasions nearly despairing of gaining our object. But at last perfect waves, easily read and easily counted, were produced, and measurements were taken with the following results.

Series	I.	II.	III.	IV.	V.	VI.	VII.
Half wave-length	98·6	98·6	97·6	98·3	100·0	98·6	97·9 mm.

Mean of all, 98·8 mm. at 18·9°.

In air, a similar series gave the numbers

Series ...	I.	II.	III.	IV.	V.
Half wave-length ...	36·00	36·03	36·11	35·89	36·16

Mean, 36·04 mm. at 20·1°

The ratio of the specific heat at constant volume to that at constant pressure for air is 1·408; that for helium is—

$$\frac{(36{\cdot}04)^2 \times (273+18{\cdot}9) \times 14{\cdot}479}{273+20{\cdot}1} : (98{\cdot}8)^2 \times 2{\cdot}218 :: 1{\cdot}408 : 1{\cdot}632$$

This sample of gas was again circulated over very hot magnesium and copper oxide for seven hours; the magnesium had no smell of ammonia when breathed on, nor did it turn red litmus paper blue until after long standing. The magnesium was mostly volatilised out of the hot part of the tube.

The *density* of this sample of gas was determined.

Volume of bulb	162·843 c.c.
Temperature	19·8°
Pressure (corr.)	730·0 mm.
Weight	0·0278 gram
Density	2·133

The wave-length of sound was re-determined in the same tube as before. The figures are

Series...	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
Half wave-length.	102·7	100·7	101·6	100·7	102·6	101·6	100·9	101·1 mm.

Mean of all, 101·5 mm.

The ratio of the specific heats of helium, calculated from these numbers as before, is 1·652, a sufficiently close approximation to the theoretical number 1·66. In the case of argon, the purest specimen obtained gave for the ratio 1·659; and as remarked (in the *Philosophical Transactions*, 1895, 52), not much dependence can be placed on the accuracy of the last figure.

The result of these experiments goes to prove that the density of the gas named helium is not less than 2·13, and that it has the same claim to be considered a monatomic gas as mercury gas; or if it is a mixture, it must be a mixture of monatomic gases.

As hydrogen was often evolved along with helium from minerals, it occurred to us that if a definite ratio could be found between the helium and the hydrogen evolved by the action of acid, some idea might be gained as to the valency of helium. It would be as if, for example, hydrogen and chlorine were evolved separately from salt by sulphuric acid, instead of in combination; by measuring each, the deduction could be drawn that chlorine was univalent. Experiments made to this end showed, however, that from some minerals no hydrogen is evolved. Gas, from a sample of uraninite sent by Dr. Hillebrand, contained no trace of hydrogen. It is, of course, possible, and, indeed, not unlikely, that all hydrogen is absorbed in reducing the uranic oxide to uranous oxide. The problem then becomes a complicated one; but we hope to solve it by future experiments.

As yet but few experiments have been made with the object of inducing helium to enter into combination. Like argon, it is not attacked by oxygen in presence of caustic soda under the action of the electric discharge; indeed, this forms a good method of removing all impurities other than argon. Again, like argon, it is not affected by red-hot magnesium, and it is not oxidised by copper oxide at a red heat.

As helium is evolved from clèveite and similar minerals at a red heat, an attempt was made to reabsorb it by heating the powdered mineral to redness in contact with the gas, but not to so high a temperature as that which had served to cause it to be evolved. But the attempt was fruitless; no gas was absorbed. When all the gas in the tubes had been pumped out, after they were cold, heating failed to cause the evolution of more gas.

A further experiment was made, in which metallic uranium was heated to bright redness with a blow-pipe in contact with a mixture of helium and oxygen, the latter gas being greatly in excess. But, curiously, the oxidation of the uranium was very slow, and all the helium was recovered, none having been absorbed. The conditions have yet to be discovered under which helium can be made to combine with oxides of uranium, so as to reproduce the natural product.

The Solubility of Helium.

Helium is very sparingly soluble in water. A determination made by the method previously described for argon (*Phil. Trans.* A, 1895, 37) gave 0·0073 as its coefficient at 18·2°. The tube contained 162·3 arbitrary divisions, of which 26·0 were occupied by helium and 136·3 by water. After shaking, the volume of the helium was reduced to 25·0 divisions, and that of the water was increased to 137·3. As 137·3 absorb 1·0, 1 volume of water absorbs 0·0073 volume. The whole apparatus was jacketed with running water during this experiment.

This is the lowest solubility hitherto recorded. Generally speaking, the solubility of a gas is related to the temperature at which it condenses to a liquid, and the sparing solubility of helium points to its having a very low boiling point. Prof. Olszewski has kindly undertaken to make experiments on the temperature of liquefaction of helium, and it will be interesting to find whether its boiling point does not lie below, or, at least, as low as that of hydrogen; for their molecular weights are not very different, and helium is a monatomic gas, a condition which appears to lower the boiling point.

Helium is totally insoluble in absolute alcohol and in benzene.

The Spectrum of Helium.

Mr. Crookes is making an exhaustive study of the spectrum of helium, and will shortly publish an account of his work. But, as some of the deductions to be drawn later depend on the lines observed, it is necessary here to add a few words. In general terms, the spectrum has already been described. The particular point to which attention is necessary here is that at least two of the lines in the spectrum of helium, seen with a wide dispersion prism, are coincident with two of the argon lines. These occur in the red, and comprise one of each of the two pairs of characteristic argon lines. This observation has been frequently repeated, using for the purpose spectroscopes of different dispersive power, and throwing into the field both spectra at the same time, with an exceedingly narrow slit; and we may say that if not absolutely identical, the lines are so near that it is not possible with the means at our disposal to recognise any difference in position. But the relative brilliancy is by no means the same. One of the argon lines, rather faint, is coincident with the prominent red of the helium spectrum, and one of the strong red argon lines is coincident with a faint red line in the helium spectrum.

Besides these two, there is a line in the orange-red, which though perhaps not identical, yet is very close. This line is faint in helium, but moderately strong in argon. It is much more easily visible with helium in the "negative glow" than in the capillary tube.

It may also be of interest to state that, according to Runge's observation, the brilliant yellow line of helium is undoubtedly a doublet. This was frequently observed by us with a grating of 14,000 lines to the inch in the spectrum of the third order. But it must also be noted that one of the lines is very faint; the other, more refrangible, is immensely brighter. The distance, judged by eye, appears to be about 1/50th part of that between the lines D_1 and D_2 of sodium. Accurate information on this last point may be looked for from Mr. Crookes, Mr. Lockyer, and from many others who are interested in the probable occurrence of this element in the sun.[1]

III. *General Conclusions.*

It cannot be doubted that a close analogy exists between argon and helium. Both resist sparking with oxygen in presence of caustic soda; both are unattacked by red-hot magnesium; and if we draw the usual inference from the ratio between their specific heats at constant volume and at constant pressure, both are monatomic gases. These properties undoubtedly place them in the same chemical class, and differentiate them from all known elements.

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[1] Prof. Hale and Dr. Huggins have recently observed that the solar line D_3 is also a doublet. (W. R., July 20).

Although opinion is divided on the precise significance of the ratio of specific heats, 1·66, it appears to be most probable that in all cases, as in that of mercury, this ratio points to the monatomicity of the molecule. If we assume this provisionally, it follows that the atomic weight of helium is identical with its molecular weight. The molecular weight is twice the density, for the molecular weights of gases are compared with the atomic weight of hydrogen, taken as unity; hence the atomic weight of helium on this assumption is $2{\cdot}13 \times 2 = 4{\cdot}26$. But again we assume, in making this calculation, that helium is a single element, and not a mixture of elements. Before discussing this question, it appears advisable to inquire whether there is any evidence which would corroborate the deduction that it is a monatomic element. This evidence must be sought for in the properties of argon, for those of helium have not as yet been sufficiently investigated.

We know from countless examples among compounds of hydrogen and carbon that increase in molecular weight is accompanied by rise of boiling point; and it may be stated as a proved fact that a polymeride has always a higher boiling point than the simpler molecule of which the polymeride is formed. Among the substances germain to this inquiry, ozone and oxygen may be cited; the complex molecule of ozone is shown by the higher temperature at which it boils. It might be concluded with certainty, therefore, that A_2, could it exist, should have a higher boiling point than A_1.

Next, it is generally the case that the boiling point of an element, provided it has not a complex molecule like that of sulphur and phosphorus, is lower, the lower its molecular weight. There are the well-known instances of chlorine, bromine, and iodine; but if it be objected that these all belong to the same group, we may cite the cases of hydrogen, –243.5°; nitrogen, –194.4°; and oxygen, –182·7°; and we may add chlorine, –102°. If argon possessed the atomic weight 20 and the molecular weight 40, it is probable that its boiling point would lie above that of chlorine, instead of, as is actually the fact, at –187°—below that of oxygen. But, it may be objected, the boiling point is determined, not by the molecular weight, but by the density. It may be urged that the density of argon is 20, and that its molecules, like those of oxygen and nitrogen, are diatomic, in spite of the argument to the contrary from the ratio of specific heats. The answer to this objection is obvious; if this were so, its boiling point should lie above, and not below that of oxygen.

These considerations cannot, of course, be accepted as evidence, but merely as corroborative of the conclusion as regards the monatomicity of argon. If they apply to argon, they apply with equal force to helium; and if they are accepted, it follows that the atomic weight of helium is 4·26.

It is again necessary to consider the character of argon in attempting to answer the next question: Are argon and helium single elements or mixtures of elements? But before discussing it, let us consider another question: How does argon happen to occur in the air and helium only in minerals? Why is helium not present in air? A satisfactory answer to this question is, we think, contained in a paper by Dr. Johnstone Stoney (*Chem. News*, 1895, lxxi. 67). He there shows that were hydrogen to be present in air (and it might be present, in spite of the oxygen with which it could be mixed, for a small quantity would surely escape combination), it would, in virtue of the velocity of its own proper molecular motion, remove itself from our planet, and emigrate to a celestial body possessing sufficient gravitational attraction to hold it fast. Dr. Stoney suggests this explanation to account for the absence of an atmosphere and of water vapour on the moon, and for the presence of an atmosphere of hydrogen on the sun. It would also account for the absence of helium in our atmosphere, and for the presence of the chromospheric line D_3. Of course if an element can form compounds, or if it is absorbed by solids, as helium appears to be, it will, like hydrogen and helium, be found on the earth.

The inertness of these gases would favour their existence in the free state. And argon exists in the atmosphere, precisely because it forms no compounds. Similarly nitrogen is a constituent of air, because in the first place those elements with which it combines directly are comparatively rare, and also because such compounds are mostly decomposed by water; and the excess of nitrogen therefore occurs in the free state. Similarly, the occurrence of free oxygen is due to the fact that some remains over, after all or almost all the readily oxidised substances have already united with oxygen. If there exist gases similar to argon in inertness, they too may be looked for in air.

Now if argon possess the atomic weight 40, there is no place for it in the periodic table of the elements. And up to now there is no exception to this orderly arrangement, if the doubtful case of tellurium be excluded. Rayleigh and Ramsay have shown that the high density of argon can hardly be accounted for by supposing that molecules of A_2 are mixed with molecules of A_1; and excluding as untenable the supposition that argon is a compound, the only remaining suggestion is that it is a mixture. No attempts have as yet been made to test the correctness of this idea; but experiments have already been started which, it is hoped, will throw light on this question.

The density of argon is too high; to fill its place in the periodic table, between chlorine and potassium, its density should be about 19 and its atomic weight 38. We might expect the presence of another element with a density of 41 and an atomic weight of 82, to follow bromine, as argon follows chlorine; and this element would probably also be a gas, since its density would be only a little higher than that of chlorine.

But here we meet with a difficulty. There are certain lines in the spectrum of helium coincident with lines in the argon spectrum. There can be only one explanation, excluding the extremely improbable hypothesis, which is not verified in any instance, that two elements may give spectra containing identical lines. That explanation is, of course, that each contains some common ingredient; and there appears to be a place for one with density 10 and atomic weight 20, to follow fluorine in the periodic table. The density of helium is, however, so low, that there does not appear room for any large quantity of a heavier gas; and to fit the periodic table, the density of argon should be diminished by removal of a heavier admixture, rather than increased by removal of a lighter one.

Such are the problems which now confront us. Until more experiments have thrown further light on the subject, we regard it as labour lost to discuss the relations of these curious elements to others which find their proper place in the periodic table.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

SIR JULIAN GOLDSMID has been elected Vice-Chancellor of the University of London, in succession to Sir James Paget, who has resigned.

THE new *Directory* of the Department of Science and Art, which has just come to hand, contains the regulations for Organised Science Schools, previously referred to in these columns. Among other matter new to the *Directory*, and announcements of changes, we notice that a new method of according the National Scholarships is in contemplation. The change will not take effect until the Session 1896–97, and due intimation of its nature will be given. The syllabus of Practical Plane and Solid Geometry has been recast in the elementary stage, in the direction already noted, and new syllabuses are given for Inorganic Chemistry, theoretical and practical, Geology, and Physiography. It is not clear, however, whether the questions to be set for the examinations next May will be based upon the new or the old syllabuses.

AT the ordinary quarterly meeting of the Royal College of Physicians of London, held on Thursday last, Sir Russell Reynolds, F.R.S., in the chair, the following gentlemen were elected officers of the College:—Censors, Sir William H. Broadbent, Dr. P. H. Pye-Smith, Dr. T. Tillyer Whipham, Dr. William Cayley; treasurer, Sir Dyce Duckworth; emeritus registrar, Sir Henry Pitman; registrar, Dr. Edward Liveing; librarian, Dr. William Munk; examiners—chemistry and chemical physics, Mr. Charles E. Groves, F.R.S., Mr. W. R. Dunstan, Mr. J. Millar Thomson, Dr. Samuel Ricleal, Dr. R. Taylor Plimpton; materia medica and pharmacy, Dr. T. Lauder Brunton, F.R.S., Dr. Daniel J. Leech, Dr. Sidney P. Phillips, Dr. Frederick Willcocks, Dr. Francis G. Penrose;